



System Wide Information Management Prototyping Activities

Duane Harkness Avaliant LLC

Paul Comitz Boeing Air Traffic Management

Agenda

- **The Data Dilemma**
- **GCNSS I**
 - **Near Term Strategies**
 - **Prototype SWIM Demonstration**
 - **Surveillance Data Network**
- **GCNSS II**
 - **Service Oriented Architecture**
- **Summary**

The Data Dilemma

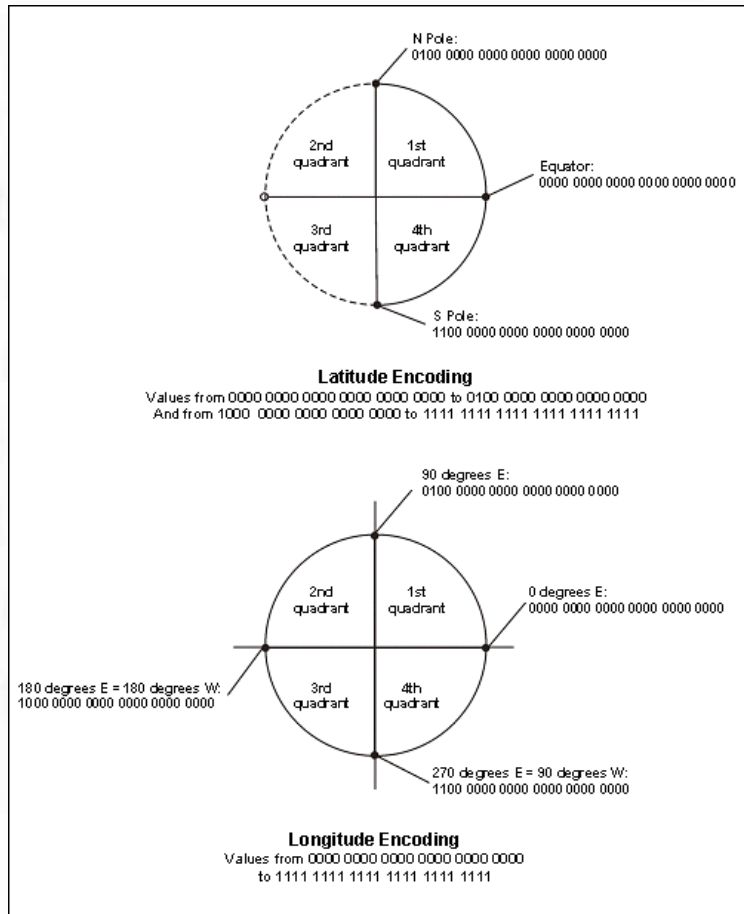
- **Poor Data Quality costs US business \$600 billion/year ¹**
- **Data Definition and distribution challenges are common**
 - **Aviation**
 - **Geography**
 - **Banking**

SWIM —————> Data definition and distribution

1. Eckerson, Wayne W., Data Quality and the Bottom Line, The Data Warehousing Institute, <http://www.dw-institute.com>

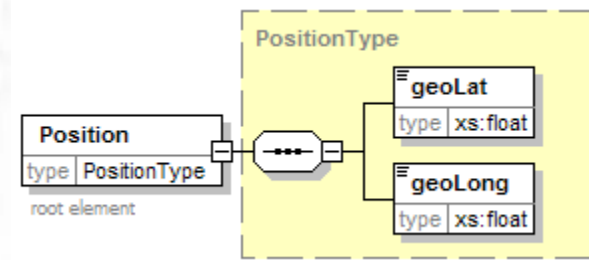
The Aviation Data Dilemma

- Current SF 21 Approach



- EuroControl AIXM Approach

```
<Position>
  <geoLat>514326.67N</geoLat>
  <geoLong>0032345.67E</geoLong>
</Position>
```



SF 21 Approach

Complex, error prone, unique

AIXM Approach

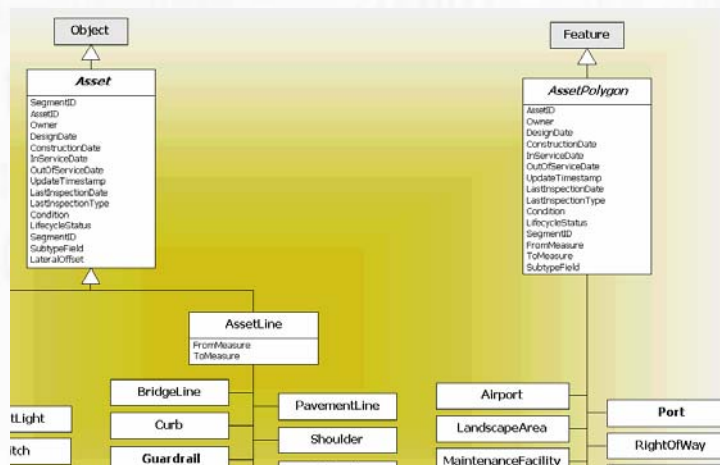
Simple, widely supported by
COTS tools

Based on ER Model

AirTrafficManagement

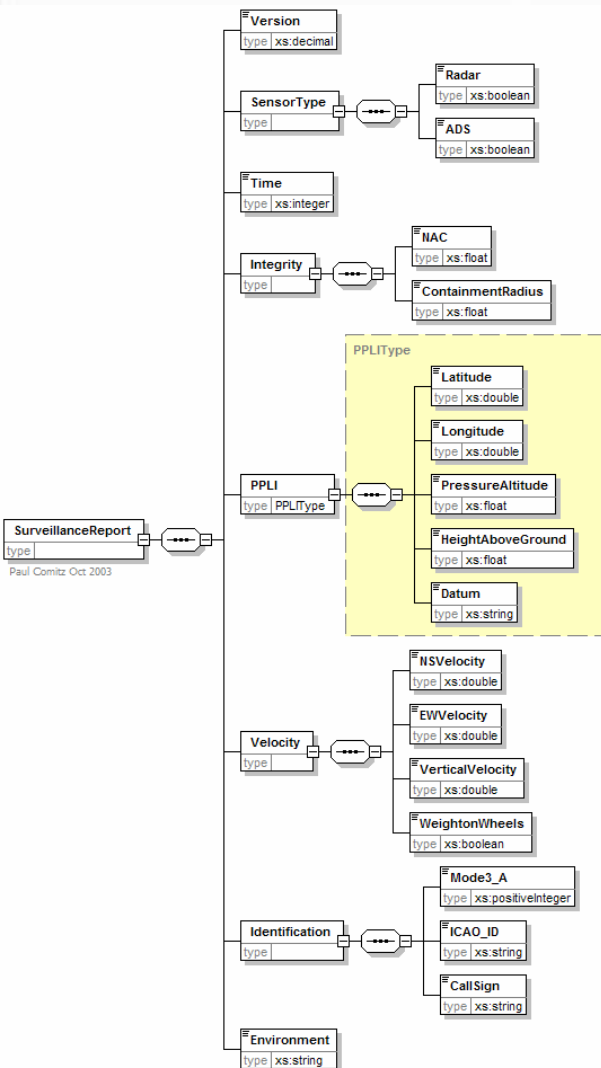
Common Data Representation

- Create/engineer/ develop
 - Air Traffic Management Data Model
 - **Leverage:**
 - EuroControl Air Information Exchange Model (AIXM)
 - EuroControl EAD Database
- Broad acceptance in industry for Spatial Data Models
 - Intel, Energy, Telecom, *Transportation*



*Example:
A data model for transportation*

Surveillance Data Model



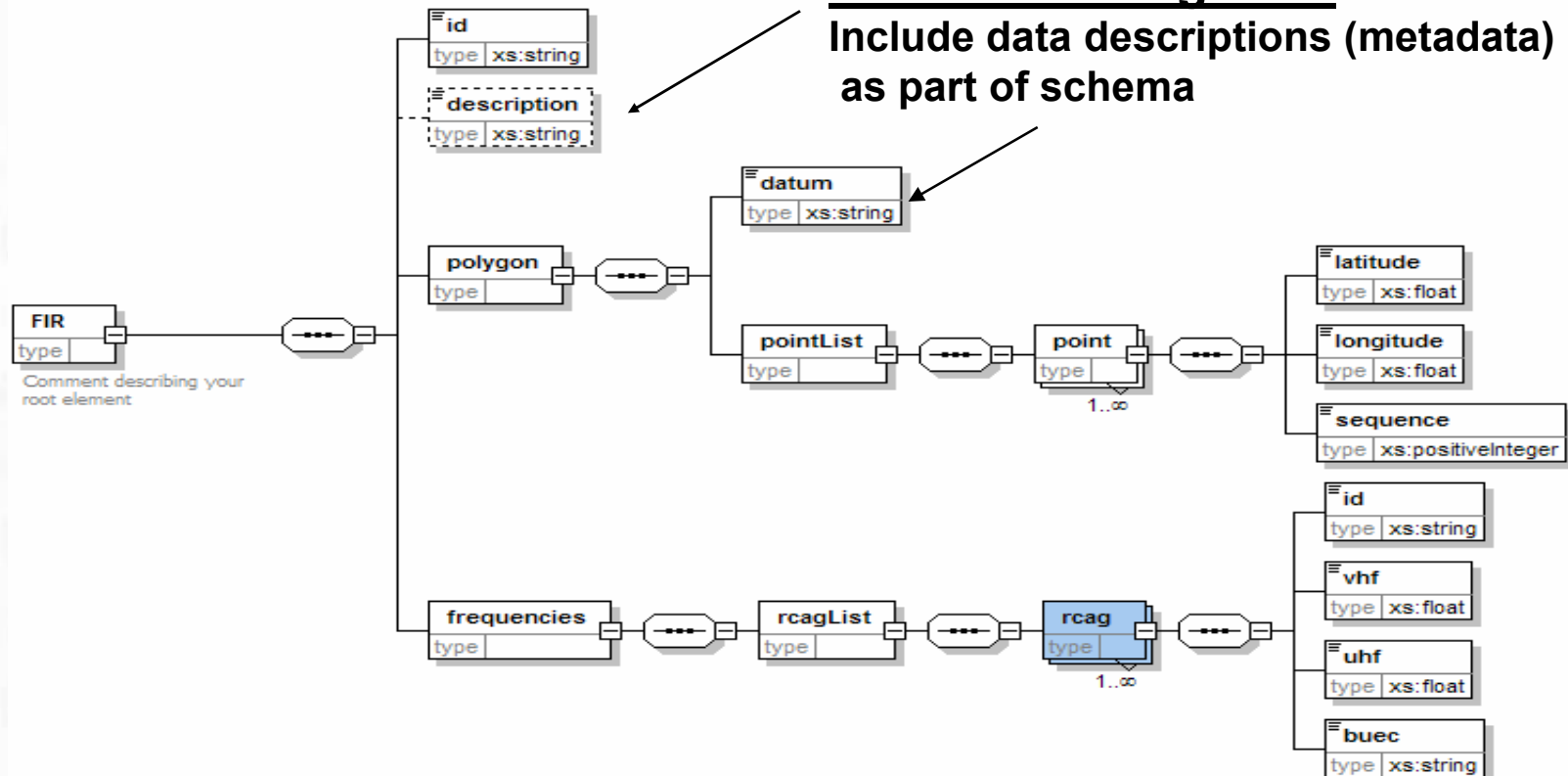
- Surveillance Data Network (SDN) Sensor Interface data stream
- Approach
 - Provide global data specification
 - Interagency Approach
 - TADIL J
 - PPLI and Environment

GCNSS

Common Schema for FIR

Self Describing Data

Include data descriptions (metadata)
as part of schema

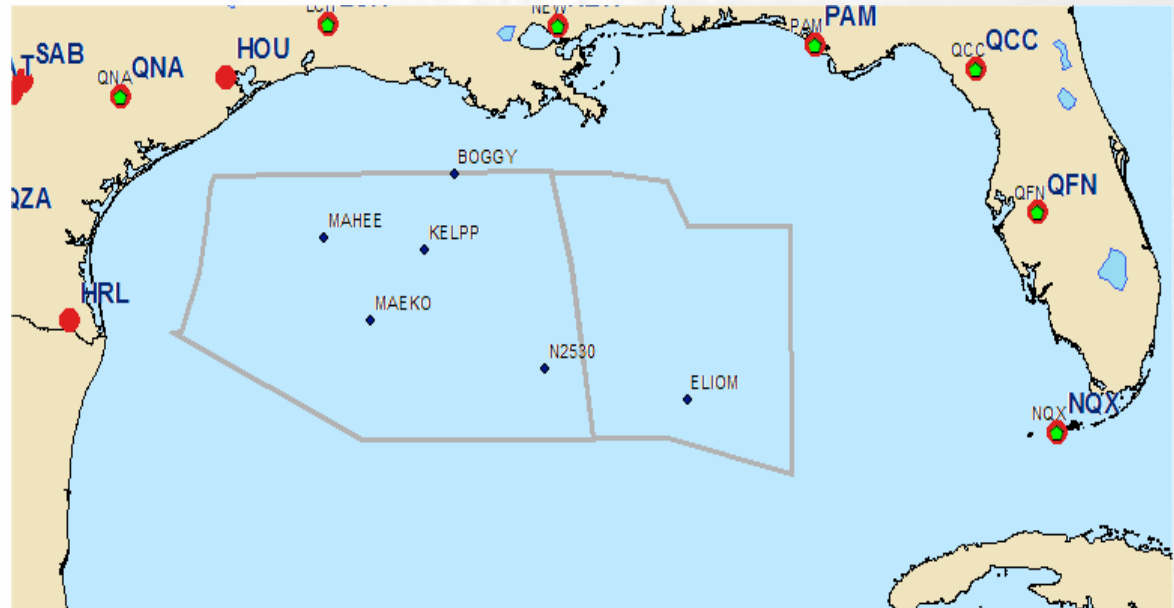


Common Data Representation allows Application Integration

Data Model for Flight Information Regions Document complies with XML schema

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- Paul Comitz August 2003 -->
<!-- Sample XML File for FIR Sector 72 Oceanic East-->
<FIR xmlns="http://www.paulhoomitz.net/namespace" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
C:\adsProject\xml\firSchema1.xsd">
  <id>String</id>
  <description>FIR Sector 72 Oceanic East OCNE</description>
  <polygon>
    <datum>WGS-84</datum>
    <pointList>
      <point>
        <latitude>24.5</latitude>
        <longitude>-89.2333</longitude>
        <sequence>1</sequence>
      </point>
      <point>
        <latitude>26.91667</latitude>
        <longitude>-89.58334</longitude>
        <sequence>2</sequence>
      </point>
      <point>
        <latitude>28.26667</latitude>
        <longitude>-89.88333</longitude>
        <sequence>3</sequence>
      </point>
      <point>
        <latitude>28.26667</latitude>
        <longitude>-89</longitude>
        <sequence>4</sequence>
      </point>
      <point>
        <latitude>28.14167</latitude>
        <longitude>-88</longitude>
        <sequence>5</sequence>
      </point>
      <point>
        <latitude>27.5</latitude>
        <longitude>-87.68333</longitude>
        <sequence>6</sequence>
      </point>
    </pointList>
  </polygon>
</FIR>
```

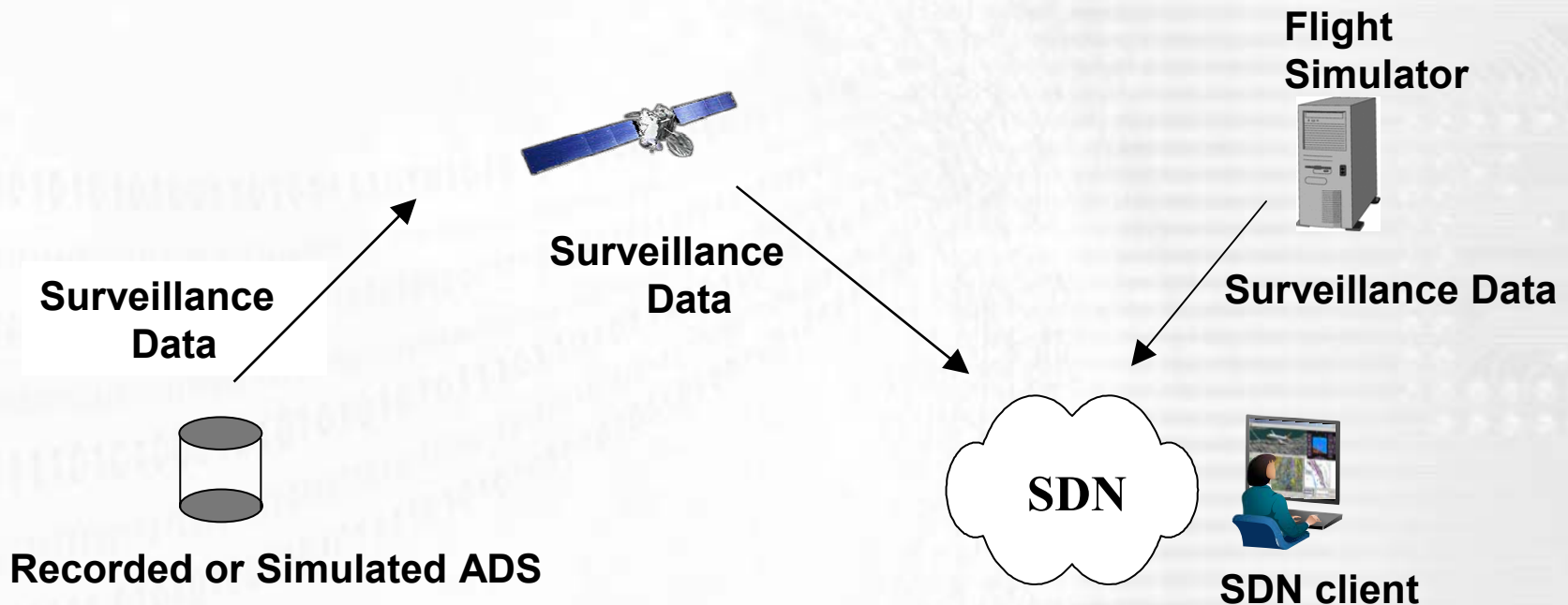
Trivial Application Integration



GCNSS Segment C

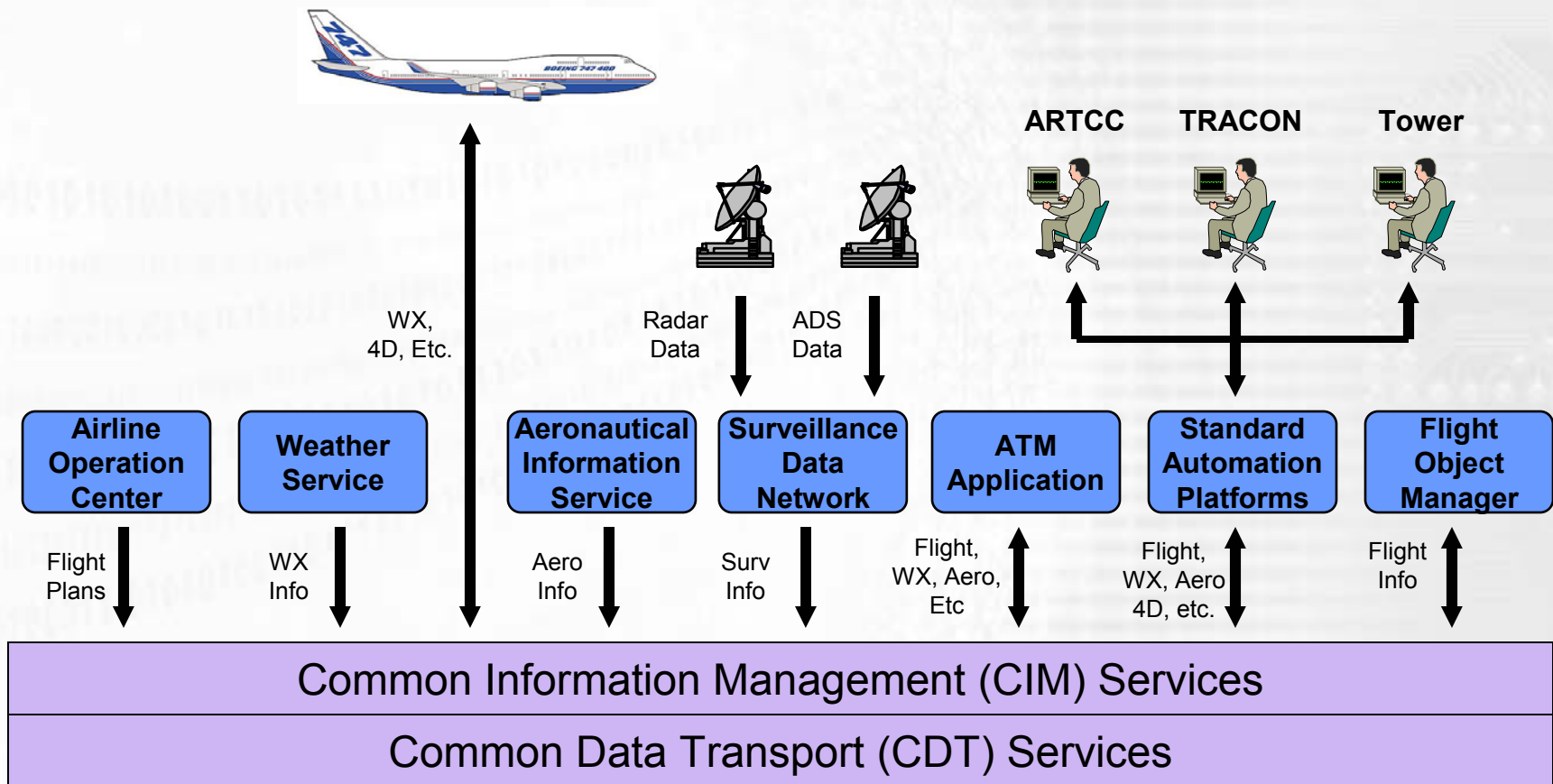
Surveillance Data Network

- Segment C Strategy
 - Based on lessons (re-) learned in Segment B



Demonstrate a Reusable Data Architecture

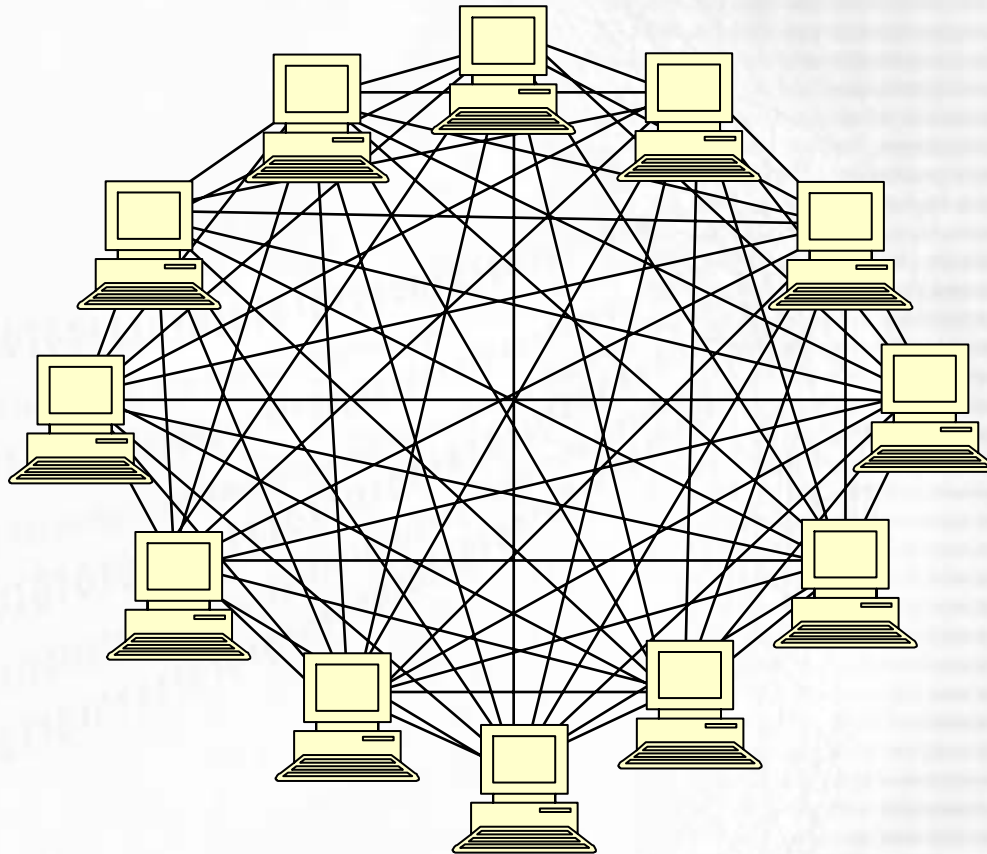
SWIM Concept



SWIM Enables –

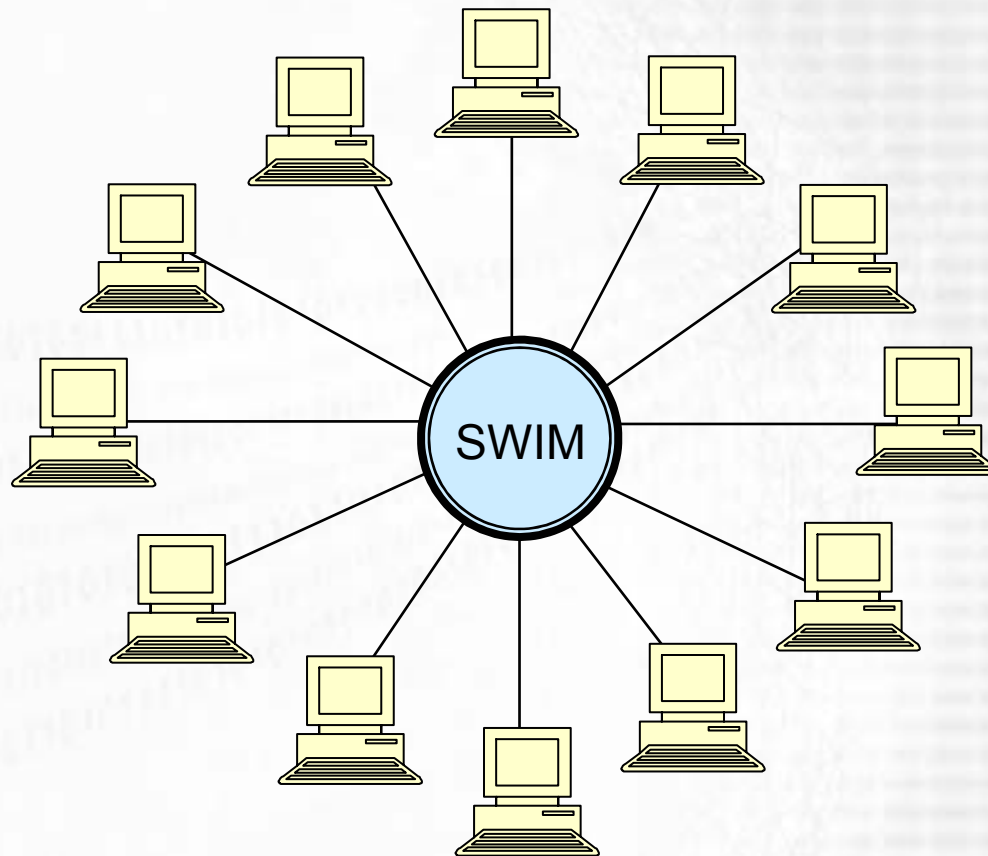
- *Information sharing*
- *Information assurance*
- *Systems integration*

Why SWIM?



$N \text{ Systems} \Rightarrow N(N-1)/2 \text{ Interfaces}$

Why SWIM?



N Systems => N Interfaces

CIN-41 SWIM Prototype

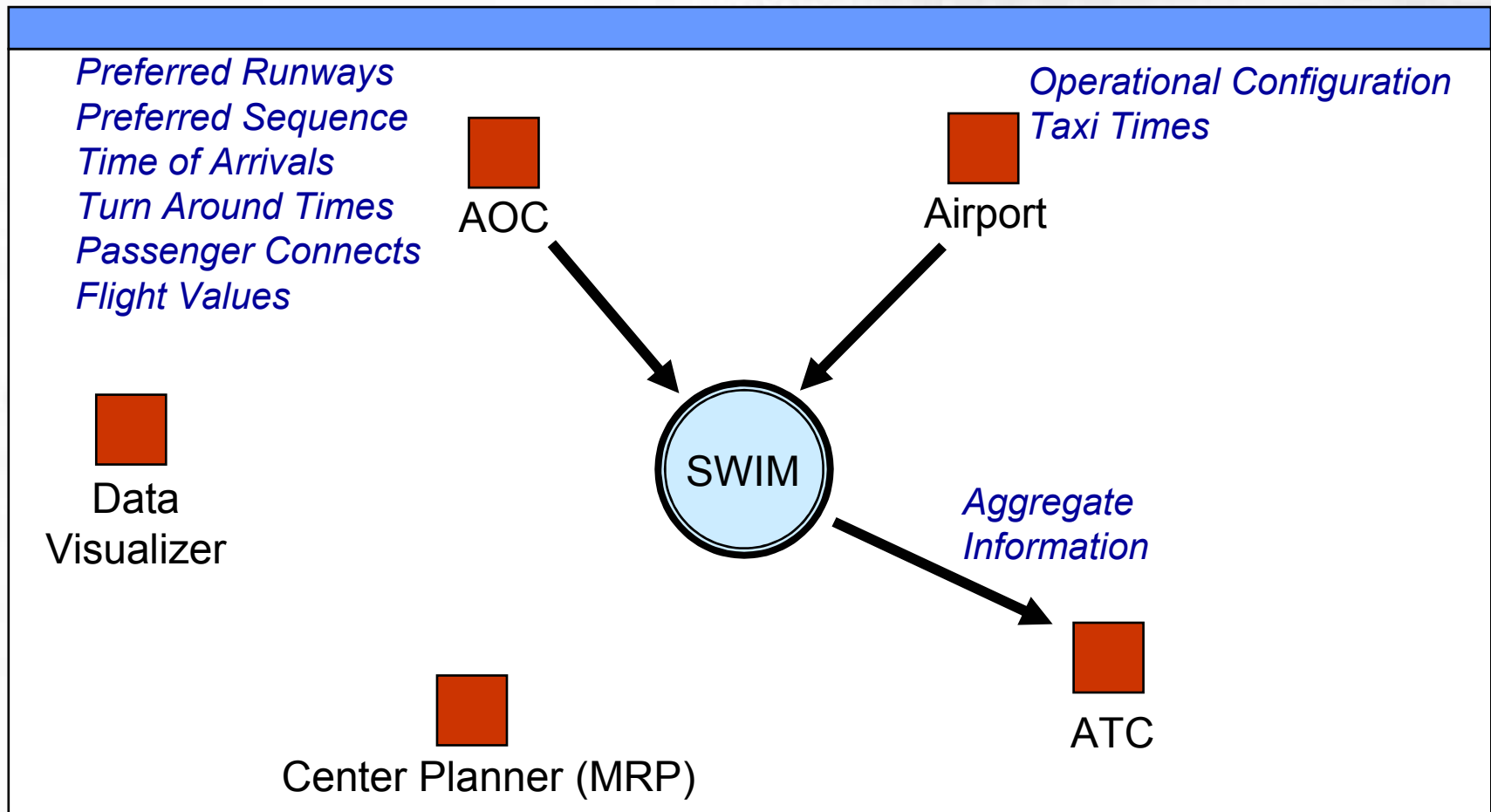
- **Objectives**

- Demonstrate SWIM integration concepts
- Model behavior of representative SWIM technologies
- Preliminary development work that is re-usable for GCNSS II

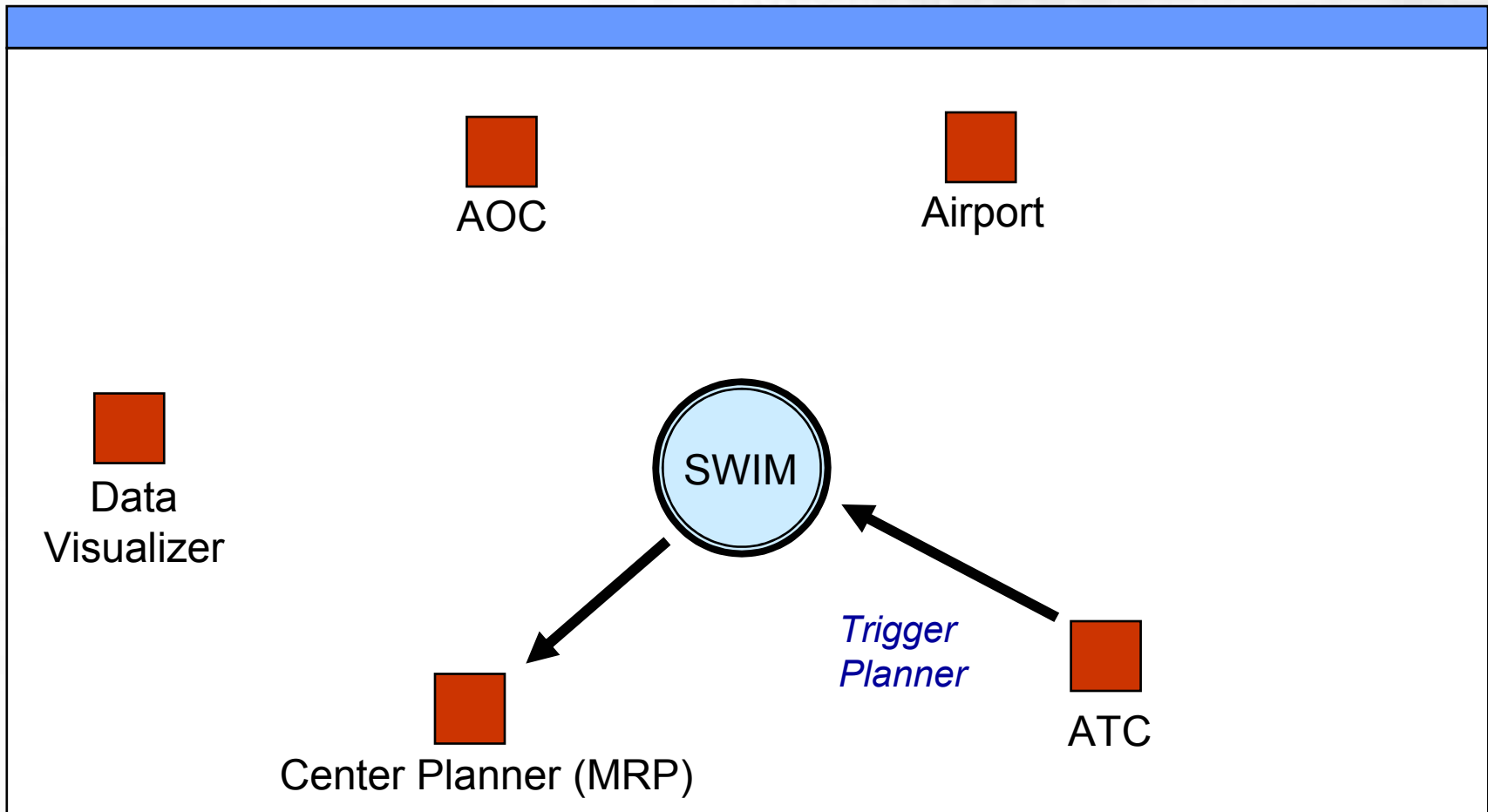
- **Approach**

- Develop simple prototype based on enhanced Arrival Management
- Focus on Common Support Services
 - Network connectivity
 - Publish/Subscribe interaction
 - XML-based information exchange
 - Service discovery

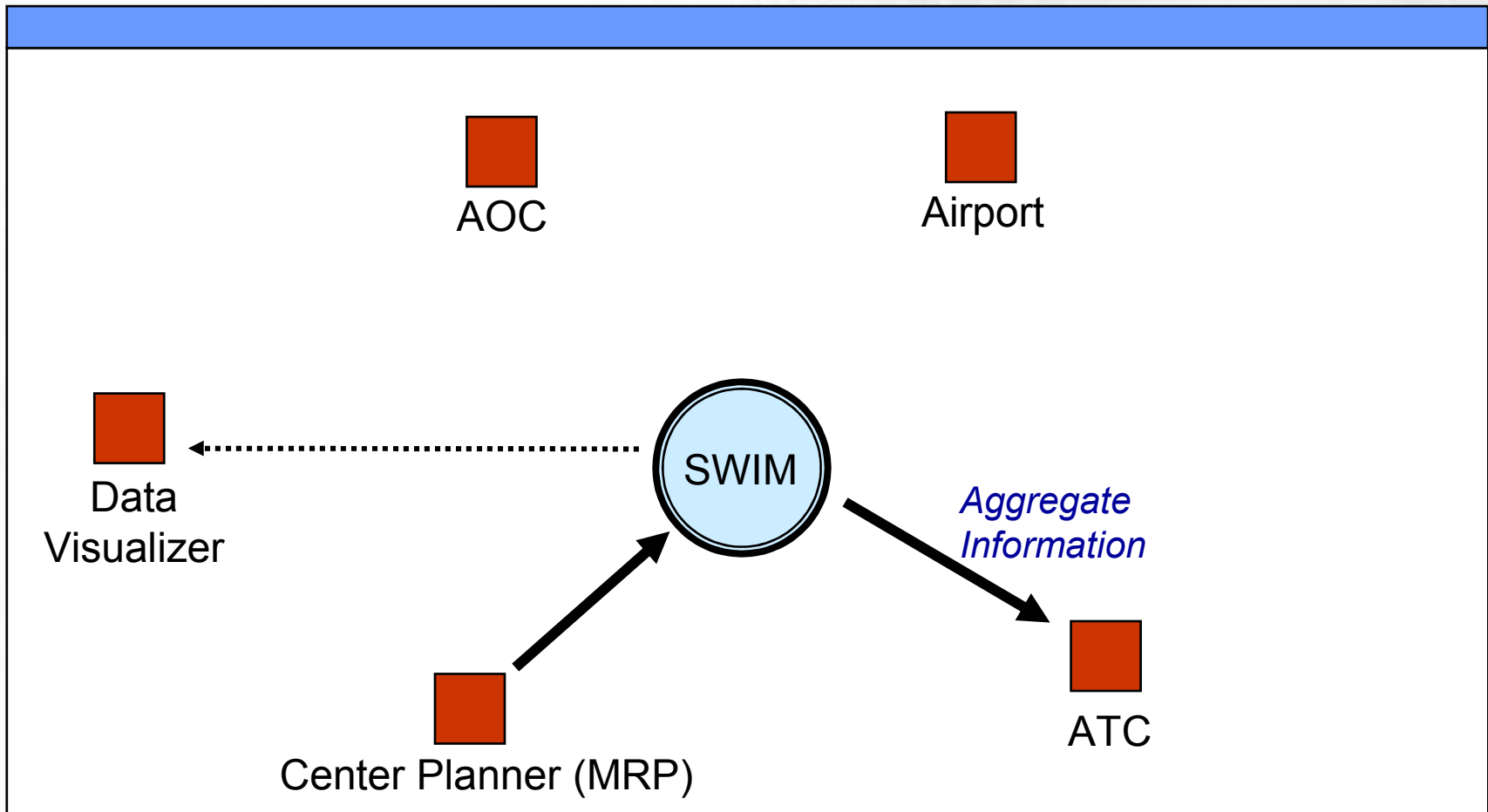
CIN-41 Demo Scenario (Step 1)



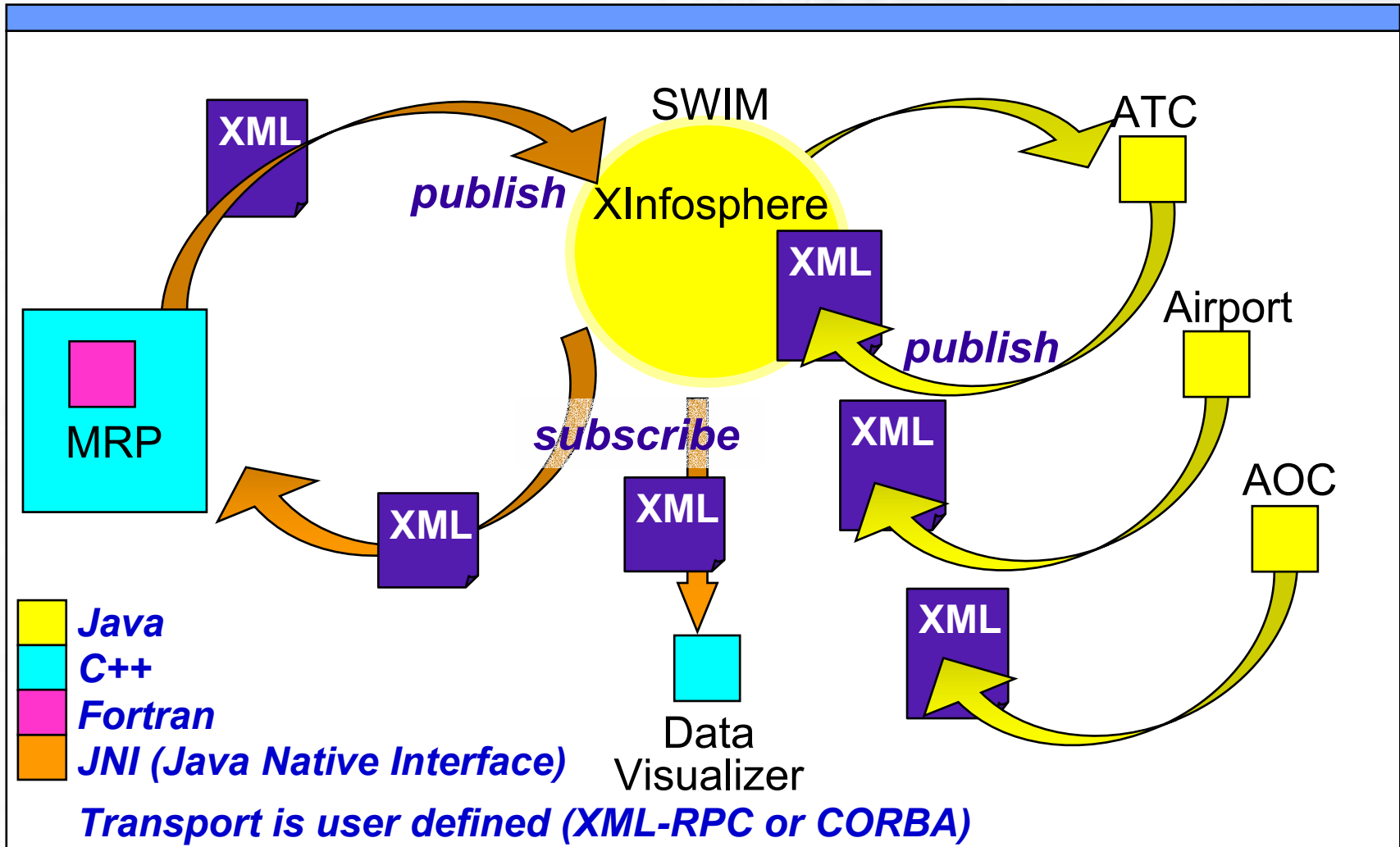
CIN-41 Demo Scenario (Step 2)



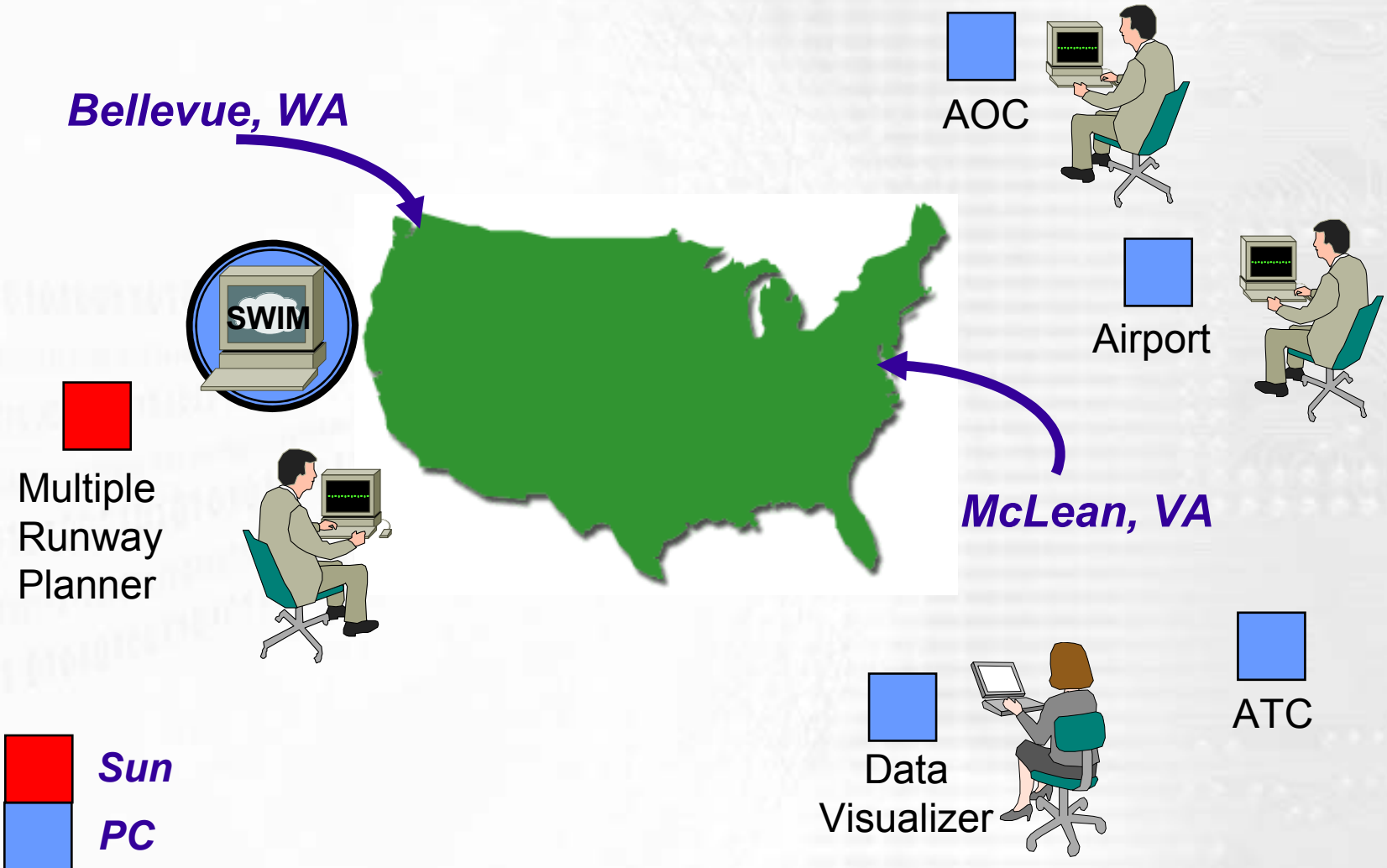
CIN-41 Demo Scenario (Step 3)



CIN-41 Demo Implementation



CIN-41 Demo Physical Setup



CIN-41 Demo DataVisualizer

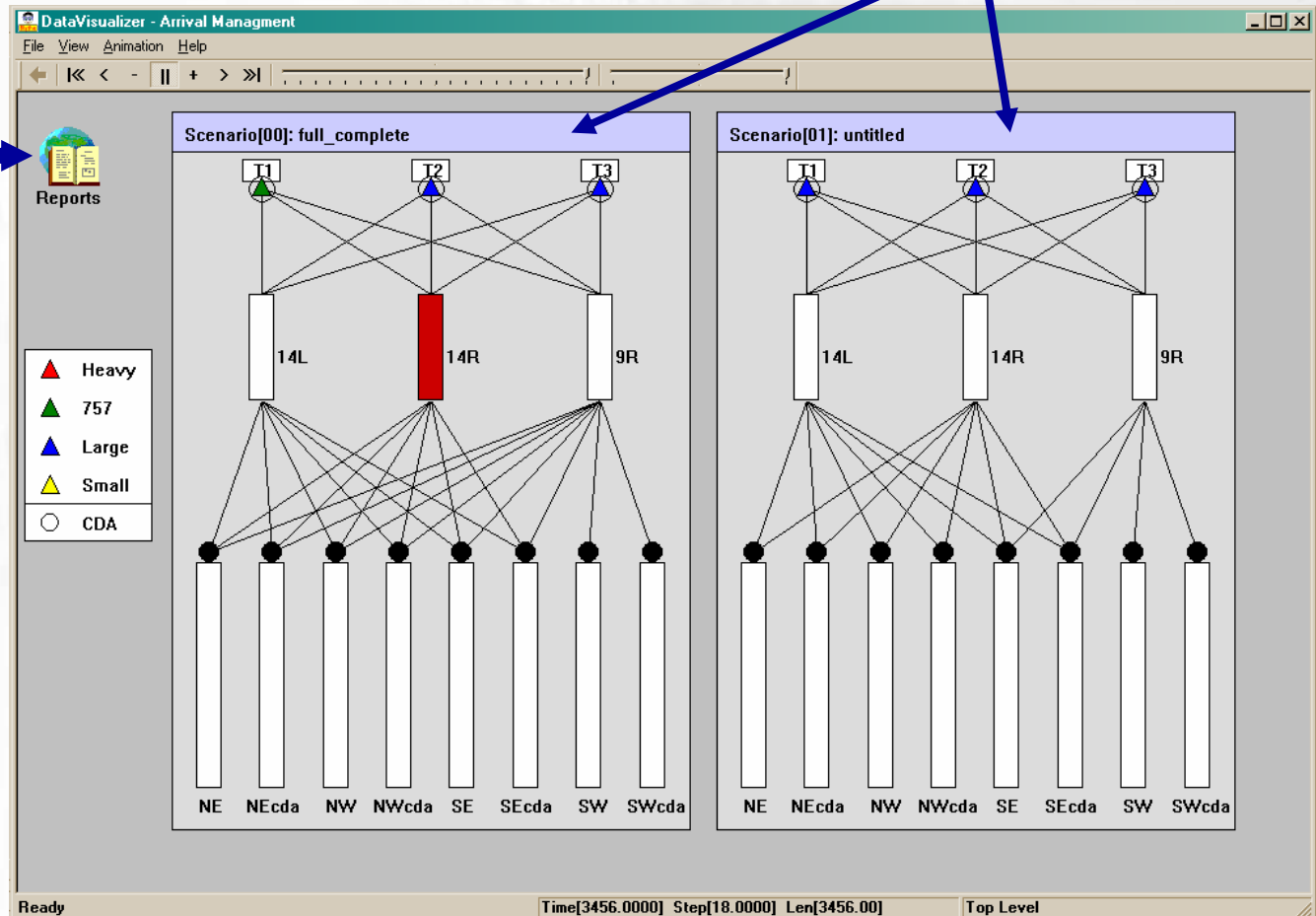
Airport Viewer

Compare Scenarios

Access Reports

- *Scenario*
- *Flight*
- *Runway*

Aircraft Classes

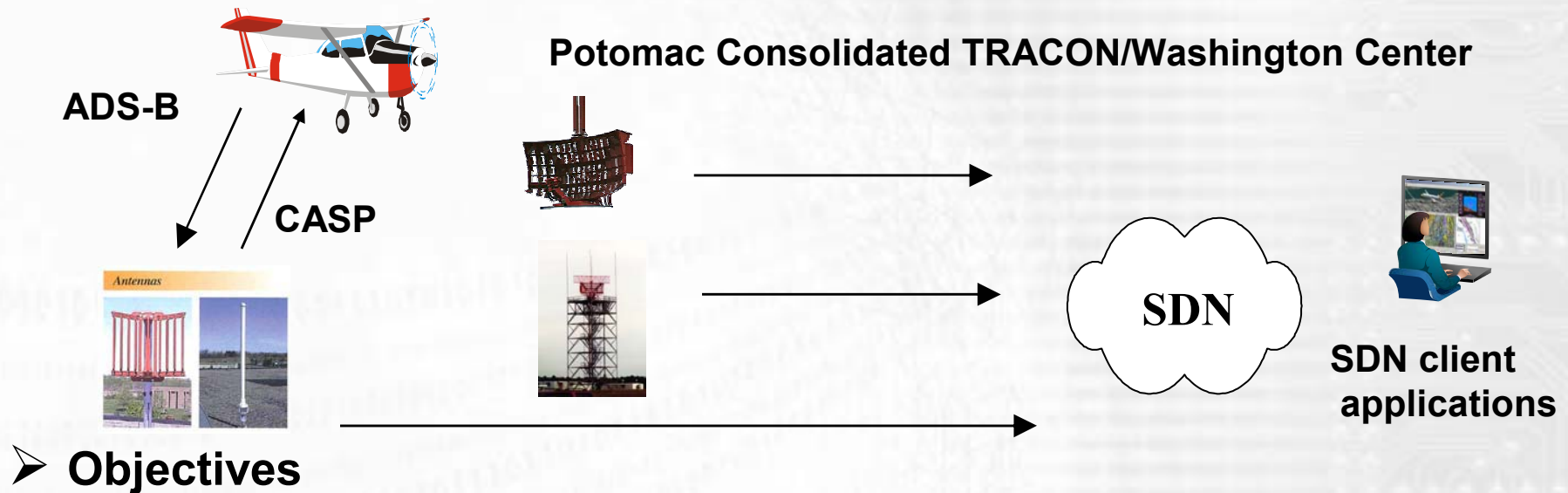


Future Steps

- Architecture:
 - Data modeling
 - SWIM architecture definition
- Prototype:
 - Explore commercially-available information management tools
 - Expand range of supported applications
 - Prototype “deployment”

GCNSS Segment C Flight Demonstrations

Flight Demonstration Objectives



- Demonstrate use of ADS-B and SDN in multi-radar terminal area
- Demonstrate a surveillance picture consistent with 3-mile enroute spacing
- Integrate multi-sensor tracking capability (fused radar & ADS-B)
- Use SDN to provide a “Common Air Surveillance Picture (CASP)” for use by Air Traffic and in support of FAA Advisory Services

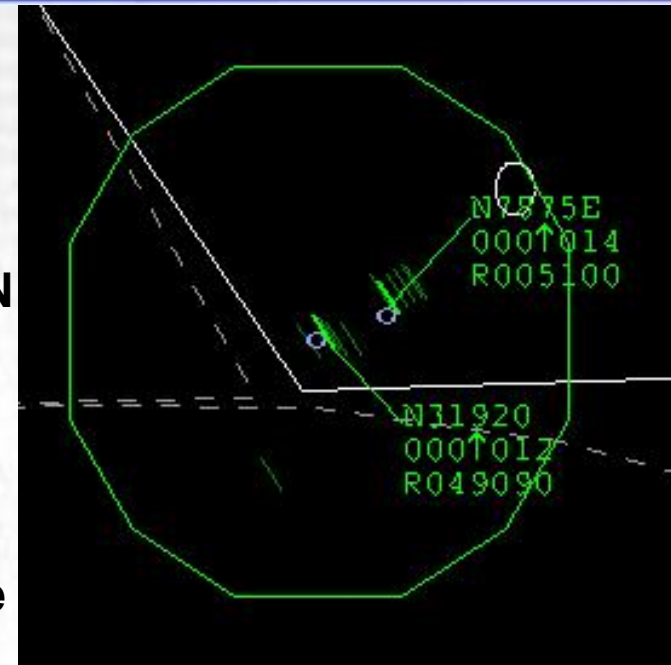
Segment C Results

➤ Test Flights Feb 19 and 23 2004

- Flew with 2 GA aircraft ADS-B/UAT equipped
- Potomac Consolidated TRACON/Washington ARTCC radar available via SDN
- Ground Based Transceivers integrated into SDN
 - Mitre CAASD , McLean Va
 - Frederick, Md.
 - WJHTC Atlantic City , NJ

➤ Successfully demonstrated:

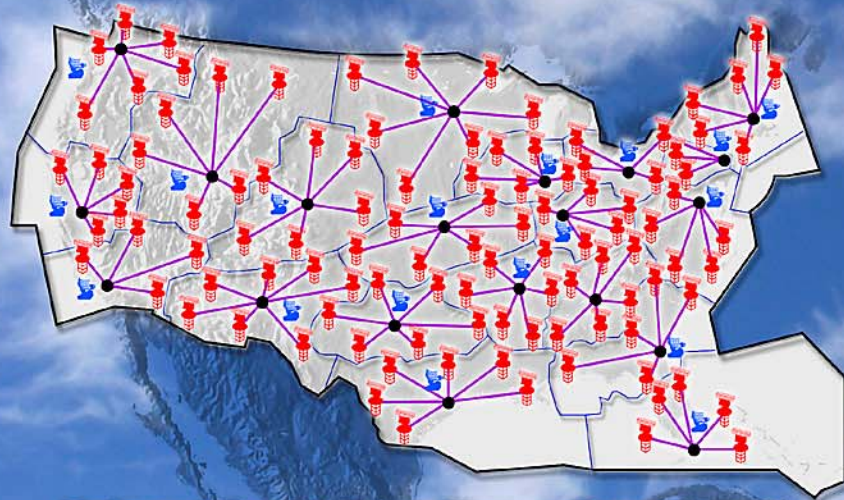
- Integration and data distribution of multiple surveillance assets
 - Output of multi-sensor tracker (MST) is a realization of a “Common Air Surveillance Picture” (CASP)
 - Cooperative targets only
- Traffic picture sent via network and CASP to test aircraft
- SDN outputs meet FAA surveillance requirements for 3-nmi separation in EnRoute airspace





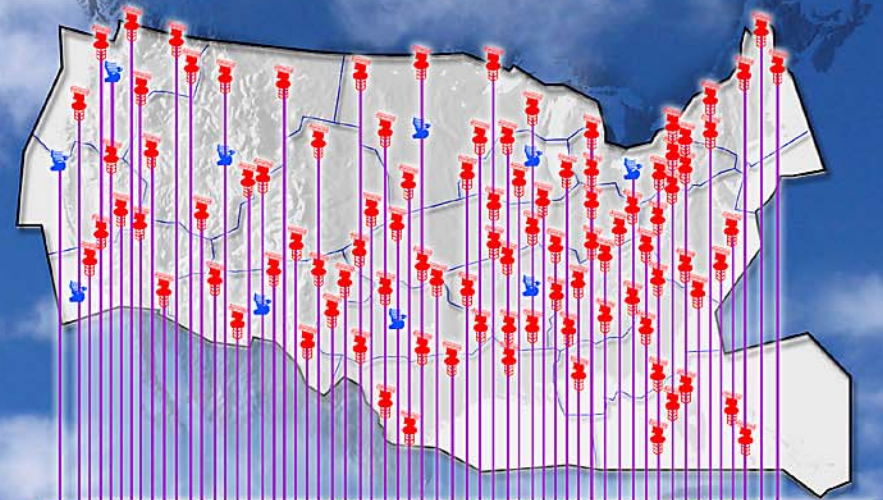
Surveillance Connectivity

Today



Hub and Spoke Surveillance Connections

Tomorrow



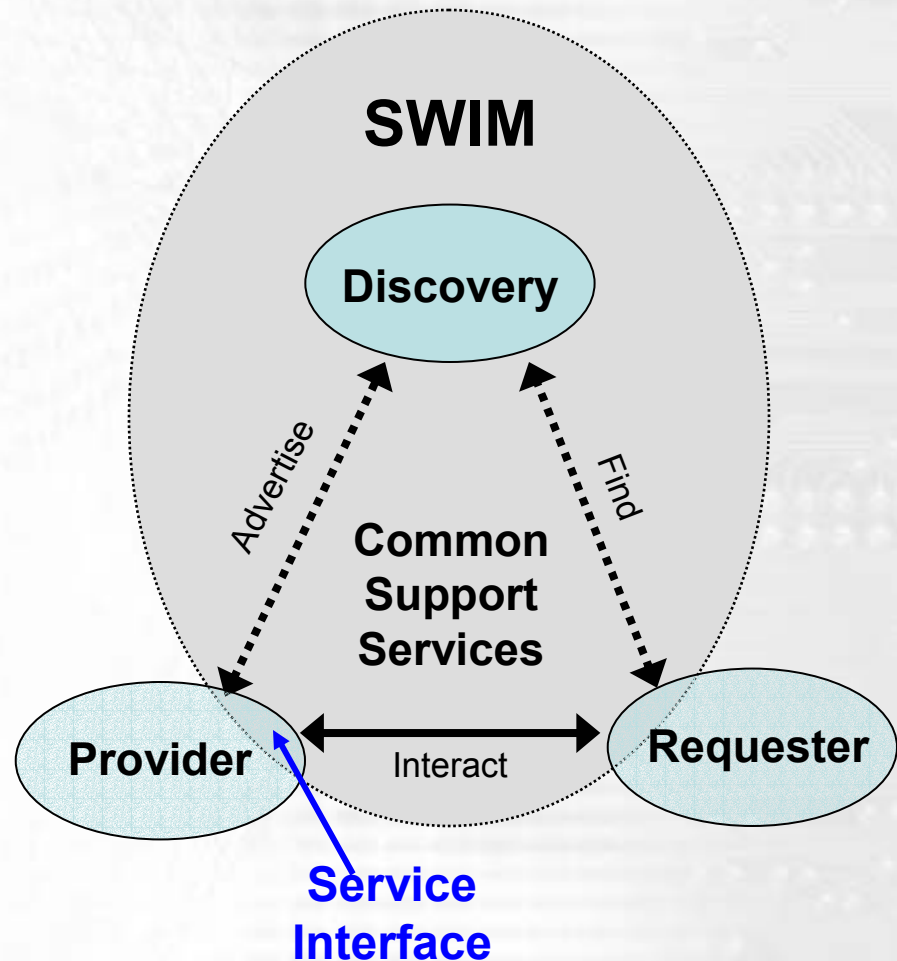
Surveillance Data Network

Air Traffic Control Homeland Security Department of Defense Department of Commerce NASA NOAA Airlines

ARSR ASR Centers Connection Lines

Service Oriented Architecture (SOA) for SWIM

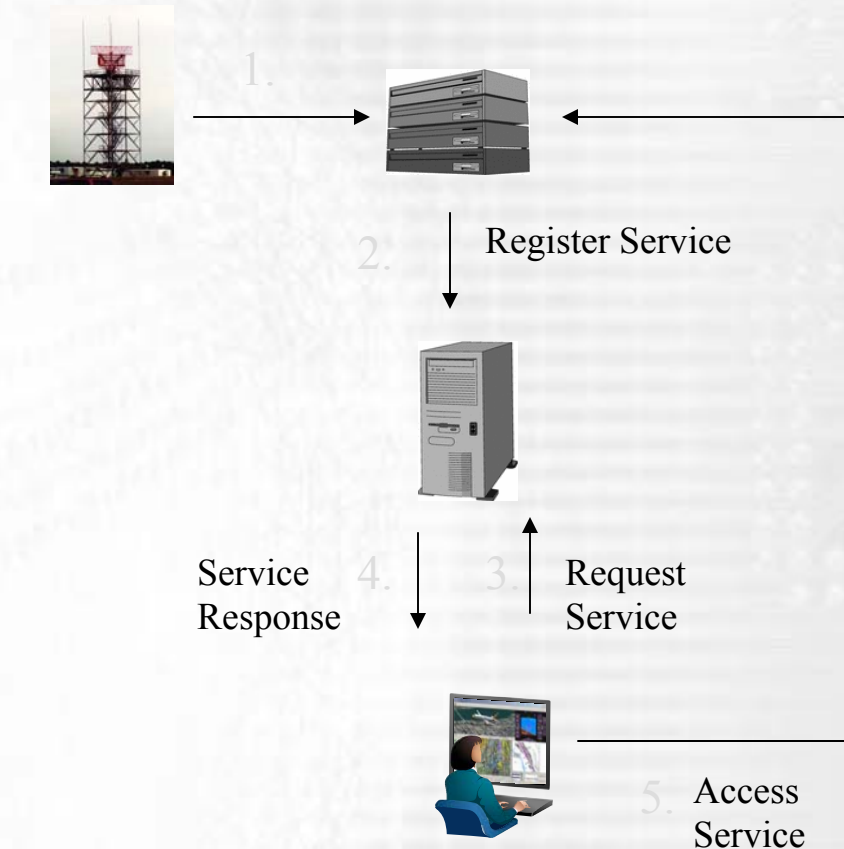
- **Provider** is any source of ATM information such as a database or application
- **Requester** is any consumer of ATM information such as a user or another application
- Requesters **Interact** with providers through a well defined **Service Interface**.
- Providers **Advertise** their service interface to SWIM so that ad hoc requesters can **Find** appropriate services via **Discovery**.
- **Common Support Services** such as security, QoS and persistence ensure interaction requirements are met.



All applications will integrate

SOA Concept : Surveillance Service

- An SOA operating concept for SWIM might include surveillance, weather, flight management, aeronautical and resource management information services
- Surveillance example:
 1. A surveillance component receives data from a sensor resource
 2. The availability of this data is published in a service directory (i.e. UDDI)
 3. An organization needing surveillance data searches the directory for an appropriate service
 4. The directory returns a reference to the service
 5. The requesting organization accesses the service directly



Applications and Data Access are loosely coupled - by design

Summary

- SWIM
 - Data definition and distribution
- Near Term
 - Reusable data models
- GCNSS 2
 - Emphasize data architecture
 - Information Architecture
 - Build concrete reference implementation
 - Not a “demo”
 - Surveillance Data Network is the “killer app” for SWIM